Dynasonics®
Ultrasonic Flow Meters

Transit Time Ultrasonic Flow Meters

TFX-5000 Meter BACnet® MS/TP Protocol

Badger Meter®

TTM-UM-03074-EN-03 (January 2022)

User Manual

CONTENTS

SUPPORTED FEATURES

TFX-5000 meters include an EIA-485 port that is selectable for Modbus RTU or BACnet MS/TP protocol. The meter can be wired on a single daisy chain network and be queried for flow rate and totalizer readings along with diagnostic and other information.

For further information on the proper installation of the transmitter, see the TFX-5000 user manual.

EIA-485 port on the TFX-5000 automatically detects which lines are A and B for transmitting and receiving. The hardware automatically corrects for the RS485 negative and positive connections being swapped.

WIRING

RS485 Output

The RS485 feature allows up to 126 transmitters to be placed on a single three-wire cable up to 4000 feet. All transmitters are assigned a unique numeric address that allows all of the transmitters on the cable network to be independently accessed. Either Modbus RTU or BACnet MS/TP protocol is used to interrogate the transmitters.

Flow rate and total can be monitored over the digital communications bus.

When a USB programming cable is connected, the RS485 and frequency outputs are disabled.

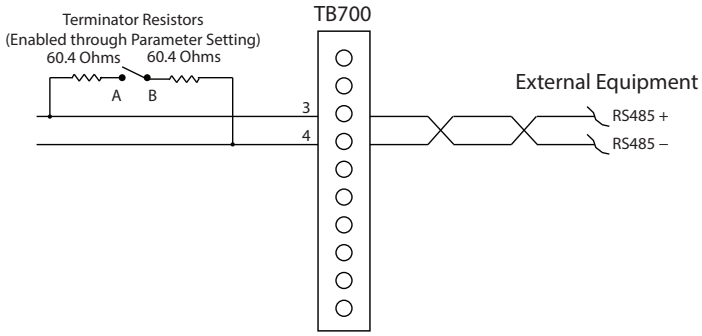

Figure 1: Typical RS485 interface

COMMUNICATION SETTINGS

To set up the meter for BACnet MS/TP:

1. Go to Main Menu > System Setup > Communication menu.
2. Select BACnet MS/TP.
3. Set the MAC address (1…254) and the BACnet ID (0…4194303).
4. Check that the baud rate, parity, stop bits and maximum MAC address match the master device.
5. Enable the terminating resistor if the meter is the last device in the network. TFX-5000 meters have a built-in resistor that can be selected through the communication setting.
6. Select whether the master can read and write or only read the data.

BACNET OBJECTS

Flow Meter Objects

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)	Large Analog Value (Double Precision 64-bit floating point)
Readings				
Flow Rate on Screen	Flow rate displayed on home screen. Unit is based on selection for home screen.	R	AV600	—
Velocity on Screen	Fluid velocity displayed on home screen. Unit is based on selection for home screen.	R	AV601	—
Delta Time Filtered (ns)	Time of flight difference between upstream and downstream used to calculated the flow rate. Units are nanoseconds.	R	AV602	—
Flow Rate (gal/min)	Flow rate in gallons/minute	R	AV800	—
Velocity (ft/sec)	Fluid velocity in feet/second	R	AV801	—
Flow Rate (l/min)	Flow rate in liters/minute	R	AV1000	—
Velocity (m/sec)	Fluid velocity in meters/second	R	AV1001	—
Totals				
Net Flow Totalizer	Total volume as forward flow minus reverse flow. A negative total results when reverse flow is greater than forward flow. Unit is based on selection for home screen.	R	AV2300	LAV2600
Positive Flow Totalizer	Total volume of flow in forward direction. Reverse flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV2301	LAV2601
Negative Flow Totalizer	Total volume of flow in reverse direction. Forward flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV2302	LAV2602
Gross Flow Totalizer	Total volume of forward and reverse flow. Unit is based on selection for home screen.	R	AV2303	LAV2603
Flow Totalizer Overflow Counter (Net)	Number of times the net flow total overruns when the net flow totalizer units are based on the home screen.	R	AV2304	—
Flow Totalizer Overflow Counter (Positive)	Number of times the positive flow total overruns when the positive flow totalizer units are based on the home screen.	R	AV2305	—
Flow Totalizer Overflow Counter (Negative)	Number of times the negative flow total overruns when the negative flow totalizer units are based on the home screen.	R	AV2306	—
Flow Totalizer Overflow Counter (Gross)	Number of times the gross flow total overruns when the gross flow totalizer units are based on the home screen.	R	AV2307	—
Net Flow Totalizer (gal)	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV2400	LAV2700
Positive Flow Totalizer (gal)	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV2401	LAV2701
Negative Flow Totalizer (gal)	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV2402	LAV2702
Gross Flow Totalizer (gal)	Total volume of forward and reverse flow.	R	AV2403	LAV2703
Totalizer Overflow Counter (Net)	Number of times the net flow total in gallons overruns.	R	AV2404	—
Totalizer Overflow Counter (Positive)	Number of times the positive flow total in gallons overruns.	R	AV2405	—
Totalizer Overflow Counter (Negative)	Number of times the negative flow total in gallons overruns.	R	AV2406	—
Totalizer Overflow Counter (Gross)	Number of times the gross flow total in gallons overruns.	R	AV2407	—
Net Flow Totalizer (liters)	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV2500	LAV2800
Positive Flow Totalizer (liters)	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV2501	LAV2801
Negative Flow Totalizer (liters)	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV2502	LAV2802
Gross Flow Totalizer (liters)	Total volume of forward and reverse flow.	R	AV2503	LAV2803
Totalizer Overflow Counter (Net)	Number of times the net flow total in liters overruns.	R	AV2504	—
Totalizer Overflow Counter (Positive)	Number of times the positive flow total in liters overruns.	R	AV2505	—
Totalizer Overflow Counter (Negative)	Number of times the negative flow total in liters overruns.	R	AV2506	—
Totalizer Overflow Counter (Gross)	Number of times the gross flow total o in liters verruns.	R	AV2507	—
Flow Rate Units	Flow rate units on home screen as defined in parameter settings.	R	MV3000	—
Velocity Units	Velocity units on home screen as defined in parameter settings	R	MV3002	—
Flow Total Units	Total volume units on home screen as defined in parameter settings	R	MV3003	—

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)	Large Analog Value (Double Precision 64-bit floating point)
Setup				
Low Flow Cutoff	Setting to display flow rate as zero & stop totalizing when flow rate goes below this value	R/W	AV4000	—
Low Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes below this value and trigger a low signal error message	R/W	AV4001	—
High Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes above this value and trigger an oversaturate error message	R/W	AV4002	—
Diagnostics				
Signal Strength	Indicates the strength of the ultrasonic signal	R	AV5500	—

Descriptive Name	Description	Network Access	Binary Output
Actions			
Reset Totalizers	Resets all flow totals in meter to zero	W	BO0
Unlatch Alarms	Unlatches outputs in alarm latched state	W	BO1
Clear Alarm History	Clears all errors, alarms and event codes from alarm history	W	BO2
Reboot Device	Reboots the meter	W	BO3

Energy Meter Objects

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)	Large Analog Value (Double Precision 64-bit floating point)
Readings				
Flow Rate on Screen	Flow rate displayed on home screen. Unit is based on selection for home screen.	R	AV600	—
Velocity on Screen	Fluid velocity displayed on home screen. Unit is based on selection for home screen.	R	AV601	—
Delta Time Filtered (ns)	Time of flight difference between upstream and downstream used to calculated the flow rate. Units are nanoseconds.	R	AV602	—
Energy/BTU Rate	Energy rate displayed on home screen. Unit is based on selection for home screen.	R	AV604	—
Temperature #1	Temperature #1 displayed on home screen. Unit is based on selection for home screen.	R	AV605	—
Temperature #2	Temperature #2 displayed on home screen. Unit is based on selection for home screen.	R	AV606	—
Delta Temperature	Delta temperature displayed on home screen. Order of operation and unit is based on selection for home screen.	R	AV607	—
Flow Rate (gal/min)	Flow rate in gallons/minute	R	AV800	—
Velocity (ft/sec)	Fluid velocity in feet/second	R	AV801	—
Energy Rate (kBTU)	Energy rate in kBTU	R	AV802	—
Flow Rate (l/min)	Flow rate in liters/minute	R	AV1000	—
Velocity (m/sec)	Fluid velocity in meters/second	R	AV1001	—
Energy Rate (kWH)	Energy rate in kWH	R	AV1002	—
Totals				
Net Flow Totalizer	Total volume as forward flow minus reverse flow. A negative total results when reverse flow is greater than forward flow. Unit is based on selection for home screen.	R	AV2300	LAV2600
Positive Flow Totalizer	Total volume of flow in forward direction. Reverse flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV2301	LAV2601
Negative Flow Totalizer	Total volume of flow in reverse direction. Forward flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV2302	LAV2602
Gross Flow Totalizer	Total volume of forward and reverse flow. Unit is based on selection for home screen.	R	AV2303	LAV2603
Flow Totalizer Overflow Counter (Net)	Number of times the net flow total overruns when the net flow totalizer units are based on the home screen.	R	AV2304	—
Flow Totalizer Overflow Counter (Positive)	Number of times the positive flow total overruns when the positive flow totalizer units are based on the home screen.	R	AV2305	—
Flow Totalizer Overflow Counter (Negative)	Number of times the negative flow total overruns when the negative flow totalizer units are based on the home screen.	R	AV2306	—
Flow Totalizer Overflow Counter (Gross)	Number of times the gross flow total overruns when the gross flow totalizer units are based on the home screen.	R	AV2307	—
Energy/BTU Net Total	Total energy as positive energy rate minus negative energy rate. A negative total results when reverse flow is greater than positive energy rate. Unit is based on selection for home screen.	R	AV2308	LAV2608
Energy/BTU Positive Total	Total energy of flow in forward direction, such as heating. Negative energy rate is not accounted for in the total. Unit is based on selection for home screen.	R	AV2309	LAV2609
Energy/BTU Negative Total	Total energy of flow in reverse direction, such as cooling. Positive energy rate is not accounted for in the total. Unit is based on selection for home screen.	R	AV2310	LAV2610
Energy/BTU Gross Total	Total energy of forward and negative energy rate (all energy to heat and cool). Unit is based on selection for home screen.	R	AV2311	LAV2611
Energy/BTU Totalizer Overflow Counter (Net)	Number of times the net energy total overruns.	R	AV2312	—
Energy/BTU Totalizer Overflow Counter (Positive)	Number of times the positive energy total overruns.	R	AV2313	—
Energy/BTU Totalizer Overflow Counter (Negative)	Number of times the negative energy total overruns.	R	AV2314	—
Energy/BTU Totalizer Overflow Counter (Gross)	Number of times the gross energy total overruns.	R	AV2315	—
Net Flow Totalizer (gal)	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV2400	LAV2700
Positive Flow Totalizer (gal)	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV2401	LAV2701
Negative Flow Totalizer (gal)	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV2402	LAV2702
Gross Flow Totalizer (gal)	Total volume of forward and reverse flow.	R	AV2403	LAV2703
Totalizer Overflow Counter (Net)	Number of times the net flow total in gallons overruns.	R	AV2404	—
Totalizer Overflow Counter (Positive)	Number of times the positive flow total in gallons overruns.	R	AV2405	—

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)	Large Analog Value (Double Precision 64-bit floating point)
Totals (continued)				
Totalizer Overflow Counter (Negative)	Number of times the negative flow total in gallons overruns.	R	AV2406	—
Totalizer Overflow Counter (Gross)	Number of times the gross flow total in gallons overruns.	R	AV2407	—
Energy/BTU Net Total (kBTU)	Total energy as positive energy rate minus negative energy rate. A negative total results when reverse flow is greater than positive energy rate.	R	AV2408	LAV2708
Energy/BTU Positive Total (kBTU)	Total energy of flow in forward direction, such as heating. Negative energy rate is not accounted for in the total.	R	AV2409	LAV2709
Energy/BTU Negative Total (kBTU)	Total energy of flow in reverse direction, such as cooling. Positive energy rate is not accounted for in the total.	R	AV2410	LAV2710
Energy/BTU Gross Total (kBTU)	Total energy of forward and negative energy rate (all energy to heat and cool).	R	AV2411	LAV2711
Net kBTU Totalizer Overflow Counter	Number of times the net energy total overruns.	R	AV2412	—
Positive kBTU Totalizer Overflow Counter	Number of times the positive energy total overruns.	R	AV2413	—
Negative kBTU Totalizer Overflow Counter	Number of times the negative energy total overruns.	R	AV2414	—
Gross kBTU Totalizer Overflow Counter	Number of times the gross energy total overruns.	R	AV2415	—
Net Flow Totalizer (liters)	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV2500	LAV2800
Positive Flow Totalizer (liters)	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV2501	LAV2801
Negative Flow Totalizer (liters)	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV2502	LAV2802
Gross Flow Totalizer (liters)	Total volume of forward and reverse flow.	R	AV2503	LAV2803
Totalizer Overflow Counter (Net)	Number of times the net flow total overruns.	R	AV2504	—
Totalizer Overflow Counter (Positive)	Number of times the positive flow total overruns.	R	AV2505	—
Totalizer Overflow Counter (Negative)	Number of times the negative flow total overruns.	R	AV2506	—
Totalizer Overflow Counter (Gross)	Number of times the gross flow total overruns.	R	AV2507	—
Energy Net Total (kWh)	Total energy as positive energy rate minus negative energy rate. A negative total results when reverse flow is greater than positive energy rate.	R	AV2508	LAV2808
Energy Positive Total (kWh)	Total energy of flow in forward direction, such as heating. Negative energy rate is not accounted for in the total.	R	AV2509	LAV2809
Energy Negative Total (kWh)	Total energy of flow in reverse direction, such as cooling. Positive energy rate is not accounted for in the total.	R	AV2510	LAV2810
Energy Gross Total (kWh)	Total energy of forward and negative energy rate (all energy to heat and cool).	R	AV2511	LAV2811
Net kWh Totalizer Overflow Counter	Number of times the net energy total overruns.	R	AV2512	—
Positive kWh Totalizer Overflow Counter	Number of times the positive energy total overruns.	R	AV2513	—
Negative kWh Totalizer Overflow Counter	Number of times the negative energy total overruns.	R	AV2514	—
Gross kWh Totalizer Overflow Counter	Number of times the gross energy total overruns.	R	AV2515	—
Flow Rate Units	Flow rate units on home screen as defined in parameter settings.	R	MV3000	—
Velocity Units	Velocity units on home screen as defined in parameter settings	R	MV3002	—
Flow Total Units	Total volume units on home screen as defined in parameter settings	R	MV3003	—
Energy Rate Units	Energy rate units on home screen as defined in parameter settings.	R	MV3006	—
Temperature Units	Temperature units on home screen as defined in parameter settings.	R	MV3008	—
Energy Total Units	Energy total units on home screen as defined in parameter settings	R	MV3009	—
Setup				
Low Flow Cutoff	Setting to display flow rate as zero & stop totalizing when flow rate goes below this value	R/W	AV4000	—
Low Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes below this value and trigger a low signal error message	R/W	AV4001	—
High Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes above this value and trigger an oversaturate error message	R/W	AV4002	—
Diagnostics				
Signal Strength	Indicates the strength of the ultrasonic signal	R	AV5500	—

Descriptive Name	Description	Network Access	Binary Output
Actions			
Reset Totalizers	Resets all flow totals in meter to zero	W	BO0
Unlatch Alarms	Unlatches outputs in alarm latched state	W	BO1
Clear Alarm History	Clears all errors, alarms and event codes from alarm history	W	BO2
Reboot Device	Reboots the meter	W	BO3

***** The BACnet Multistate Values may support more states than are available on the TFX-5000 meter. Only the states available on the TFX-5000 are shown below.

Units of Measure Enumerations

Parameter	Enumeration
Flow Rate Units	1. Liters per second
	2. Liters per minute
	3. Liters per hour
	4. Cubic meters per second
	5. Cubic meters per minute
	6. Cubic meters per hour
	7. Cubic feet per second
	8. Cubic feet per minute
	9. Cubic feet per hour
	10. Gallons per second
	11. Gallons per minute
	12. Gallons per hour
	13. Mega gallons per day
	14. Imperial gallons per second
	15. Imperial gallons per minute
	16. Imperial gallons per hour
	19. Oil Barrels per minute
	20. Mega Imperial gallons per day
	21. Oil Barrels per day
	22. Acre feet per day
	23. Fluid barrels per day
	24. Imperial barrels per day
	25. Custom flow rate
Velocity Units	1. Meters per second
	10. Feet per second
Flow Total Units	1. Liters
	2. Hectoliters
	3. Cubic meters
	4. Cubic feet
	5. Gallons
	6. Mega gallons
	7. Imperial gallons
	10. Acre Feet
	11. Oil Barrels (BBL)
	12. Imperial MegaGallons (MIGAL)
	13. Liquid Barrels (FBBL)
	17. Custom

Parameter	Enumeration
Energy Rate Units	1. Custom
	2. Watts
	3. Kilowatts
	4. Mega Watts
	5. British thermal units per hour
	6. Thousand British thermal units per hour
	7. Million British thermal units per hour
	8. KiloJoule per hour
	9. Mega Joule per hour
	10. Kilocalorie per hour
	11. Megacalorie per hour
	12. Ton of refrigeration
Temperature Units	1. Degrees Celsius
	2. Degrees Fahrenheit
	3. Degrees Kelvin
Energy Total Units	1. Custom
	2. Watt-Hour
	3. KiloWatt-Hour
	4. MegaWatt-Hour
	5. BTU
	6. kBTU
	7. MMBTU
	8. KiloJoule
	9. MegaJoule
	10. KiloCalorie
	11. MegaCalorie
	12. Ton-Hours

WARNING AND ALARM MESSAGE CODES

Failure Codes

NOTE: F01 indicates that the bootloader could not start the firmware application, so it is not possible to record this failure in the alarm history.

Code	Description
F02 ELECTRONIC ERROR	Multiple watchdog timeouts occurred.
F03 ELECTRONIC ERROR	Voltage levels are out of specification.
F10 LOW SIGNAL	Signal strength is below cutoff.
F11 HIGH SIGNAL	Signal strength is oversaturated.
F20 RTD #1 ERROR	Unable to detect RTD #1.
F21 RTD #2 ERROR	Unable to detect RTD #2.

Check Function Codes

Code	Description
C01 CURRENT TEST	Current output is in test mode.
C10 OUTPUT #1 FREQUENCY TEST	Output #1 is in frequency test mode.
C11 OUTPUT #1 PULSE TEST	Output #1 is in pulse test mode.
C12 OUTPUT #1 SWITCH TEST	Output #1 is forced on or off.
C20 OUTPUT #2 FREQUENCY TEST	Output #2 is in frequency test mode.
C21 OUTPUT #2 PULSE TEST	Output #2 is in pulse test mode.
C22 OUTPUT #2 SWITCH TEST	Output #2 is forced on or off.
C30 OUTPUT #3 FREQUENCY TEST	Output #3 is in frequency test mode.
C31 OUTPUT #3 PULSE TEST	Output #3 is in pulse test mode.
C32 OUTPUT #3 SWITCH TEST	Output #3 is forced on or off.
C41 AUX #1 PULSE TEST	Aux Output #1 is in pulse test mode.
C42 AUX #1 SWITCH TEST	Aux Output #1 is forced on or off.
C51 AUX #2 PULSE TEST	Aux Output #2 is in pulse test mode.
C52 AUX #2 SWITCH TEST	Aux Output #2 is forced on or off.
C60 SIMULATION MODE	Meter is running flow simulation.

Out-of-Specification Codes

Code	Description	Correction
S01 ELECTRONIC WARNING	Fault detected and meter rebooted.	Contact factory, update firmware, or repair or replace transmitter.
S02 DEFAULT FAILED	Reset to factory defaults failed.	Check calibration. If it does not match the calibration settings on the transducer serial tag, enter field calibration settings. Return to the *Home Screen* and continue to operate (if the reset to factory defaults is through the transmitter).
S03 LANGUAGE FILE CORRUPT	English only.	Update firmware.
S10 mA TOO HIGH	Flow or energy rate higher than flow rate at 20 mA output.	Check the scaling of the Current #1 output.
S11 mA TOO HIGH	Flow or energy rate higher than 20 mA.	Check the scaling of the Current #2 output.
S12 mA TOO HIGH	Flow or energy rate higher than 20 mA.	Check the scaling of the HART output.
S19 mA SUPPLY VOLTAGE ERR	Supply voltage out of range for 4-20 mA outputs.	Check wiring.
S20 FREQ HIGH	Value higher than max. frequency output.	Check the scaling of the frequency on Output #1.
S21 FREQ HIGH	Value higher than max. frequency output.	Check the scaling of the frequency on Output #2.
S22 FREQ HIGH	Value higher than max. frequency output.	Check the scaling of the frequency on Output #3.
S30 PULSE HIGH	Pulse output is too fast for the pulse width.	Check the scaling factor, units and pulse width of the pulse on Output #1.
S31 PULSE HIGH	Pulse output is too fast for the pulse width.	Check the scaling factor, units and pulse width of the pulse on Output #2.
S32 PULSE HIGH	Pulse output is too fast for the pulse width.	Check the scaling factor, units and pulse width of the pulse on Output 3.
S33 PULSE HIGH	Pulse output is too fast for the pulse width.	Check the scaling factor, units and pulse width of the pulse on Aux Output #1 dry contact.
S34 PULSE HIGH	Pulse output is too fast for the pulse width.	Check the scaling factor, units and pulse width of the pulse on Aux Output #2 dry contact.
S40 HIGH FLOW	Flow rate is above high flow alarm setting.	Check flow rate and Set High setting for Output #1.
S41 HIGH FLOW	Flow rate is above high flow alarm setting.	Check flow rate and Set High setting for Output #2.
S42 HIGH FLOW	Flow rate is above high flow alarm setting.	Check flow rate and Set High setting for Output #3.
S43 HIGH FLOW	Flow rate is above high flow alarm setting.	Check flow rate and Set High setting for Aux Output #1.
S44 HIGH FLOW	Flow rate is above high flow alarm setting.	Check flow rate and Set High setting for Aux Output #2.
S45 LOW FLOW	Flow rate is below low flow alarm setting.	Check flow rate and Set Low setting for Output #1.
S46 LOW FLOW	Flow rate is below low flow alarm setting.	Check flow rate and Set Low setting for Output #2.
S47 LOW FLOW	Flow rate is below low flow aram setting.	Check flow rate and Set Low setting for Output #3.
S48 LOW FLOW	Flow rate is below low flow aram setting.	Check flow rate and Set Low setting for Aux Output #1.
S49 LOW FLOW	Flow rate is below low flow aram setting.	Check flow rate and Set Low setting for Aux Output #2.
S50 TOTAL OVERFLOW	Accumulated flow total is greater than viewable digits.	Check the totalizer units or reset the flow total to clear the overflow counter.
S60 COMM TIMEOUT	Modbus master or BACnet device communication packet.	Check master device poll rate and offline status. Check wiring and termination resistor setting.
S61 MODULE TIMEOUT	Network timeout.	Check communication settings and wiring.
S62 DISCONNECTED	Bluetooth connection timed out.	—
S63 BLUETOOTH FAIL	Unable to initialize Bluetooth.	Update firmware. If error repeats, repair or replace transmitter.
S64 MODULE FAILED	Unable to initialize module.	Reseat module and reboot trnasmitter. If error repeats, replace module.
S65 MODULE MISMATCH	Module installed does not match settings.	Replace module with correct module. Check card type settings.
S67 DATA LOG ERROR	SD micro card is missing or full.	Check SD micro card. If data logging is not required, disable data logging.
S70 TEMP #1 LOW	Temp. #1 is below low alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Output #1.
S71 TEMP #1 LOW	Temp. #1 is below low alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Output #2.
S72 TEMP #1 LOW	Temp. #1 is below low alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Output #3.
S73 TEMP #2 LOW	Temp. #1 is below low alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Aux Output #1.
S74 TEMP #2 LOW	Temp. #1 is below low alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Aux Output #2.
S75 TEMP #1 HIGH	Temp. #1 is above high alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Output #1.
S76 TEMP #1 HIGH	Temp. #1 is above high alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Output #2.
S77 TEMP #1 HIGH	Temp. #1 is above high alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Output #3.
S78 TEMP #1 HIGH	Temp. #1 is above high alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Aux Output #1.
S79 TEMP #1 HIGH	Temp. #1 is above high alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Aux Output #2.
S80 HIGH ENERGY RATE	Flow rate is above high flow alarm setting.	Check energy flow rate and Set High setting for Output #1.
S81 HIGH ENERGY RATE	Flow rate is above high flow alarm setting.	Check energy flow rate and Set High setting for Output #2.
S82 HIGH ENERGY RATE	Flow rate is above high flow alarm setting.	Check energy flow rate and Set High setting for Output #3.
S83 HIGH ENERGY RATE	Flow rate is above high flow alarm setting.	Check energy flow rate and Set High setting for Aux Output #1.
S84 HIGH ENERGY RATE	Flow rate is above high flow alarm setting.	Check energy flow rate and Set High setting for Aux Output #2.
S85 LOW ENERGY RATE	Flow rate is above low flow alarm setting.	Check energy flow rate and Set Low setting for Output #1.
S86 LOW ENERGY RATE	Flow rate is above low flow alarm setting.	Check energy flow rate and Set Low setting for Output #2.
S87 LOW ENERGY RATE	Flow rate is above low flow alarm setting.	Check energy flow rate and Set Low setting for Output #3.
S88 LOW ENERGY RATE	Flow rate is above low flow alarm setting.	Check energy flow rate and Set Low setting for Aux Output #1.
S89 LOW ENERGY RATE	Flow rate is above low flow alarm setting.	Check energy flow rate and Set Low setting for Aux Output #2.
S90 TEMP #2 LOW	Temp. #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #1.
S91 TEMP #2 LOW	Temp. #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #2.

Code	Description	Correction
S92 TEMP #2 LOW	Temp. #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #3.
S93 TEMP #2 LOW	Temp. #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Aux Output #1.
S94 TEMP #2 LOW	Temp. #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Aux Output #2.
S95 TEMP #2 HIGH	Temp. #2 is above high alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #1.
S96 TEMP #2 HIGH	Temp. #2 is above high alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #2.
S97 TEMP #2 HIGH	Temp. #2 is above high alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #3.
S98 TEMP #2 HIGH	Temp. #2 is above high alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Aux Output #1.
S99 TEMP #2 HIGH	Temp. #2 is above high alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Aux Output #2.

Informational Events Codes

Information events are only displayed in the ALARM HISTORY and not on the *Home Screen*.

I01 POWER ON	Power on or rebooted.
I11 ZERO	Meter zeroed.
I12 FACTORY CALIBRATION	Calibration changed from Field to Factory.
I13 FIELD CALIBRATION	Calibration changed from Factory to Field.
I21 FIRMWARE CHANGED	Firmware updated.
I31 FLOW TOTAL RESET	Flow total reset to zero.
I41 NO SD CARD	Micro SD card not installed.

TROUBLESHOOTING

Symptoms	Possible Causes	Recommended Action
No communication	Transmit and receive are wired incorrectly.	Check the network wiring from the meter.
	Baud rate does not match master.	Check the baud rate of the master and ensure the baud rate of the meter matches the master. If it does not match, change the Baud Rate setting in the Modbus RTU Communication menu.
	Parity and stop bits do not match the master.	Check that the settings are compatible with the master. If it does not match, change the Parity or Stop Bit setting in the BACnet MS/TP Communication menu.
	MAC address is not unique. Another device is on the network with the same address.	Check the addresses of the other devices on the network. Check that the slave address is not 1.
	Cable is not terminated properly.	For BACnet MS/TP on EIA-485 network, devices can be daisy chained together. The two devices on the end of the chain need to have terminated resistors. Terminating resistors can be enabled through the BACnet MS/TP Communication menu.
	Cable or chain longer than 4000 feet.	For BACnet MS/TP on EIA-485 network, the full length of the network cannot exceed 4000 feet. Check the length of the cabling.
Intermittent communication	Cable is not properly shielded.	Communication cables must have shielding to protect the quality of the communication signals from electromagnetic interference (EMI). Check that the cable has a shield. Typically, one end of the shield drain is connected to a clean ground to dissipate EMI and prevent ground loops. However, depending on the ground quality, cable length and type of interference, other methods can be employed.
	Cable routed near power cables such a variable frequency drives.	Cables carrying high currents cause a high degree of electromagnetic interference that can interfere with the quality of the communication signals. Route signal cables away from power cables.
	Cable is not terminated properly.	For BACnet MS/TP on EIA-485 network, devices can be daisy chained together. The two devices on the end of the chain need to have terminated resistors. Terminating resistors can be enabled through the BACnet MS/TP Communication menu.
	Cable or chain longer than 4000 feet.	For BACnet MS/TP on EIA-485 network, the full length of the network cannot exceed 4000 feet. Check the length of the cabling.
Unable to write specific parameters	Transmitter is set up for read-only.	These settings are commonly used to prevent accidental or unauthorized changes to a device over a network. Check the Access setting in the BACnet MS/TP menu.

CONFORMANCE STATEMENT

ANNEX A - PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (NORMATIVE)
(This annex is part of this Standard and is required for its use.)

BACnet Protocol Implementation Conformance Statement

Date: 3/6/20
Vendor Name: Badger Meter, Inc.
Product Name: TFX-5000 Ultrasonic Clamp-on Flow Meter
Product Model Number: TFX-5000
Application Software Version: N/A **Firmware Revision:** 2.02.480 **BACnet Protocol Revision:** 12

Product Description:
Clamp-on ultrasonic flow meter designed for measuring water.

BACnet Standardized Device Profile (Annex L):

☐ **BACnet Operator Workstation (B-OWS)**
☐ **BACnet Advanced Operator Workstation (B-AWS)**
☐ **BACnet Operator Display (B-OD)**
☐ **BACnet Building Controller (B-BC)**
☐ **BACnet Advanced Application Controller (B-AAC)**
■ **BACnet Application Specific Controller (B-ASC)**
☐ **BACnet Smart Sensor (B-SS)**
☐ **BACnet Smart Actuator (B-SA)**

List all BACnet Interoperability Building Blocks Supported (Annex K):
- Data Sharing-ReadProperty-B (DS-RP-B)
- Data Sharing-WriteProperty-B (DS-WP-B)
- Data Sharing - ReadProperty Multiple - B (DS-RPM-B)
- Data Sharing - WriteProperty Multiple - B (DS-WPM-B)
- Device Management-Dynamic Device Binding-B (DM-DDB-B)
- Device Management-Dynamic Object Binding-B (DM-DOB-B)
- Device Management-DeviceCommunicationControl-B (DM-DCC-B)

Segmentation Capability:

☐ Able to transmit segmented messages Window Size _____
☐ Able to receive segmented messages Window Size _____

Standard Object Types Supported:
- 1 Device Object
- 6 Notification Class Objects
- 73 Analog Value Objects
- 6 Multistate Value Objects

ANNEX A - PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (NORMATIVE)

Data Link Layer Options:

☐ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), Foreign Device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
☐ ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s) _____
☐ MS/TP master (Clause 9), baud rate(s):_____
■ MS/TP slave (Clause 9), baud rate(s): 9600, 19200, 38400, 57600, 76800, 115,200
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s):_____
☐ Point-To-Point, modem, (Clause 10), baud rate(s): _____
☐ LonTalk, (Clause 11), medium: _____
☐ BACnet/ZigBee (ANNEX O)
☐ Other: _____

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes ■ No

Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
☐ Annex H, BACnet Tunneling Router over IP
☐ BACnet/IP Broadcast Management Device (BBMD)
Does the BBMD support registrations by Foreign Devices? ☐ Yes ■ No
Does the BBMD support network address translation? ☐ Yes ■ No

Network Security Options:

■ Non-secure Device - is capable of operating without BACnet Network Security
☐ Secure Device - is capable of using BACnet Network Security (NS-SD BIBB)
☐ Multiple Application-Specific Keys:
☐ Supports encryption (NS-ED BIBB)
☐ Key Server (NS-KS BIBB)

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

■ ISO 10646 (UTF-8/ ANSI X3.4) ☐ IBM™/Microsoft™ DBCS ☐ ISO 8859-1
☐ ISO 10646 (UCS-2) ☐ ISO 10646 (UCS-4) ☐ JIS X 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

Not supported.

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